

# *WET ANTENNA STUDIES*

## *NASA Langley Research Center*

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### SUMMARY OF PRESENTATION

- EXPERIMENT OVERVIEW
  - EXPERIMENTAL RESULTS
- THEORY vs. EXPERIMENT
- CONCLUSIVE REMARKS

# EXPERIMENT OVERVIEW

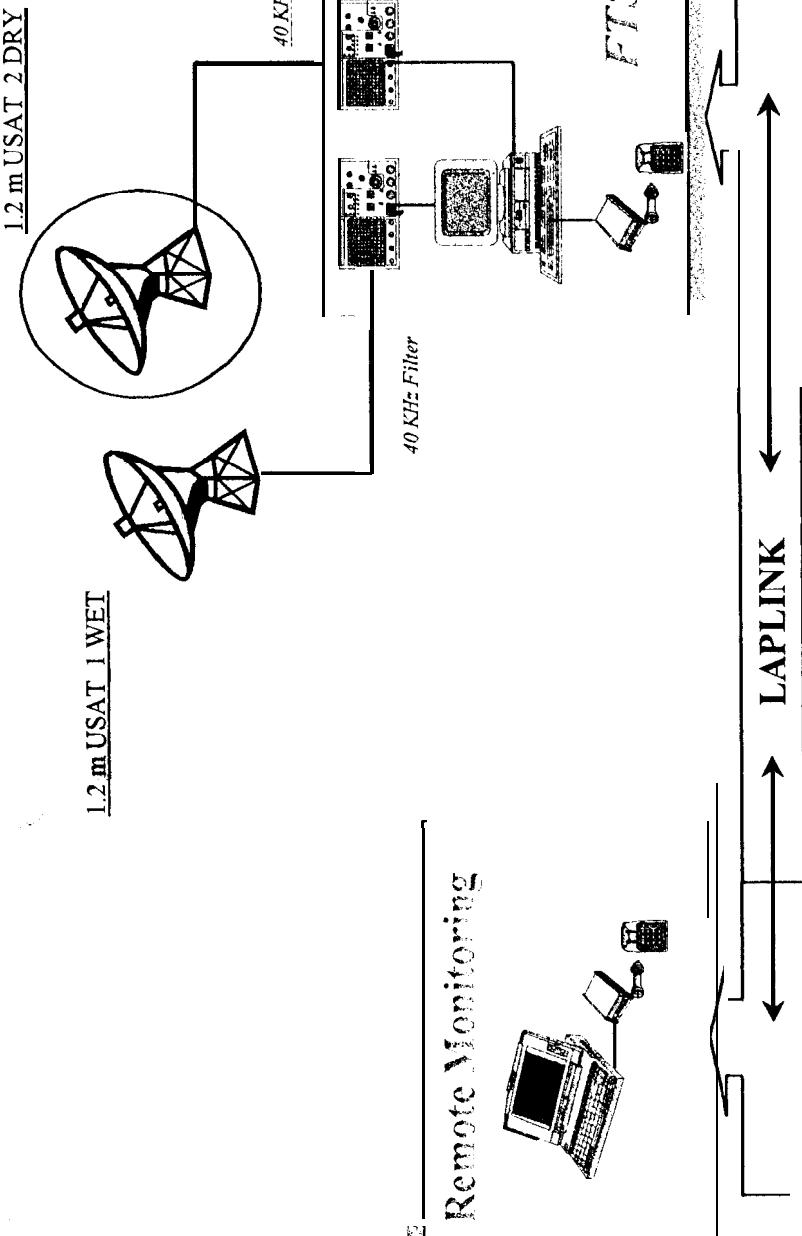
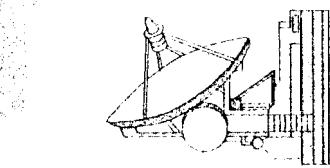
## ACTS

Uplink

Cleveland Fixed

$0.3^{\circ}$

$0.0^{\circ}$

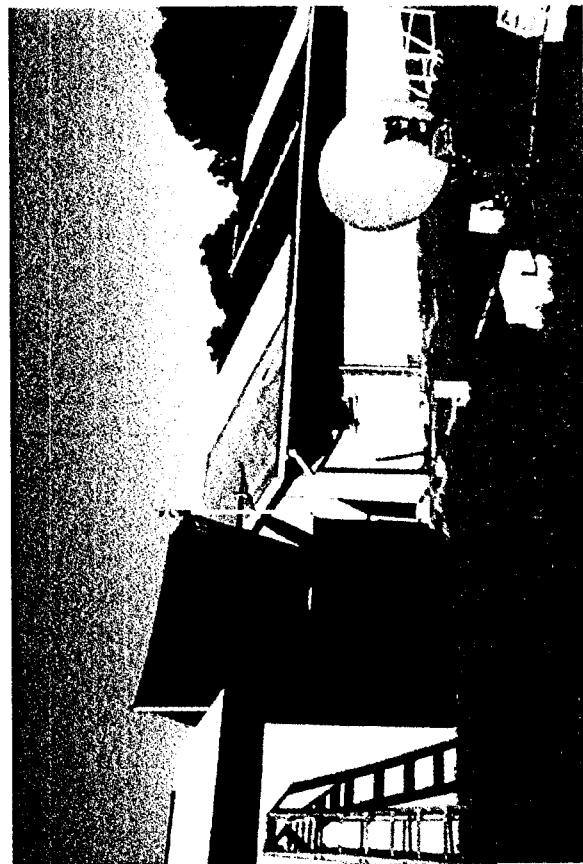


# EXPERIMENT OVERVIEW

## Wet Reflector



## Dry Reflector



## Data Acquisition Set-up



# ANTENNA WETTING FACTOR - EXPERIMENT

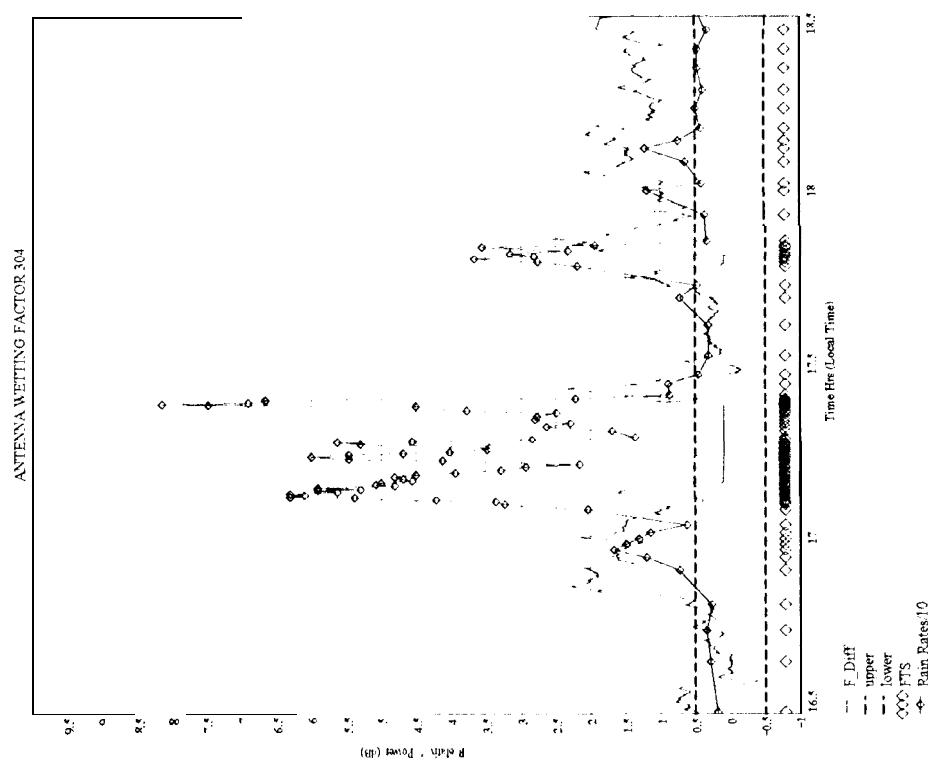


Fig. 1 - Rain Event 304

# ANTENNA WETTING FACTOR - EXPERIMENT

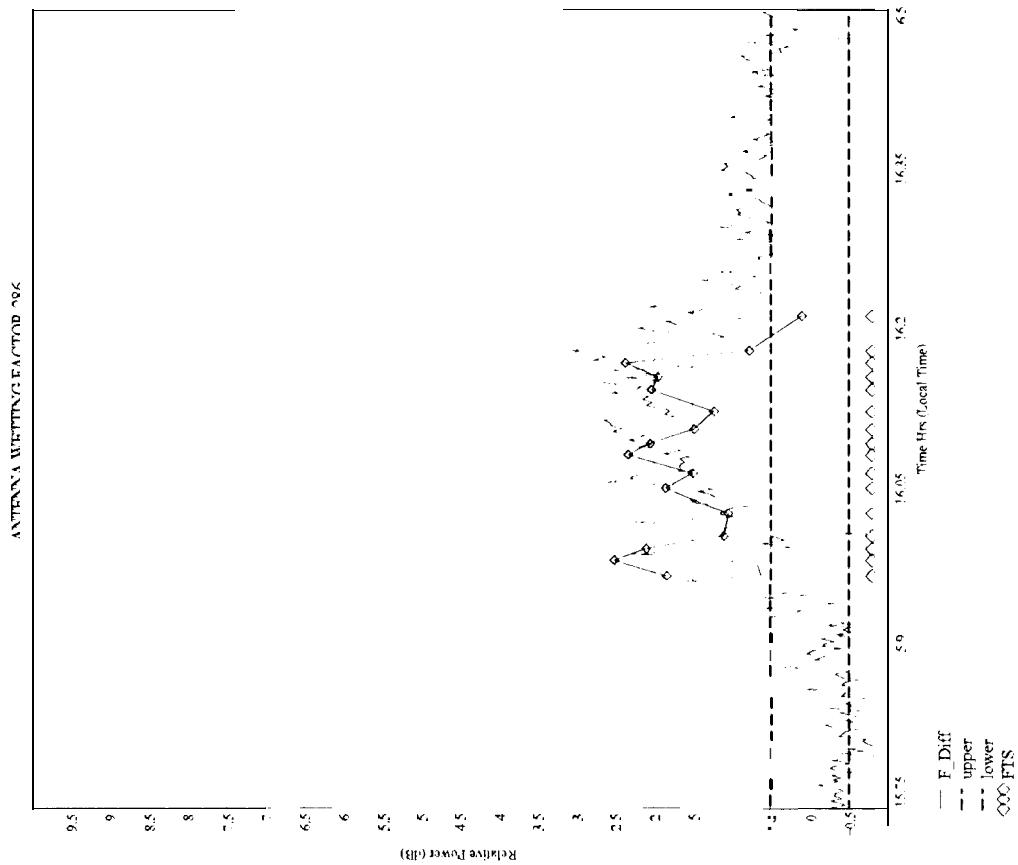


Fig. 2 - Rain Event 286

# ANTENNA METTINGFACTOR - EXPERIMENT

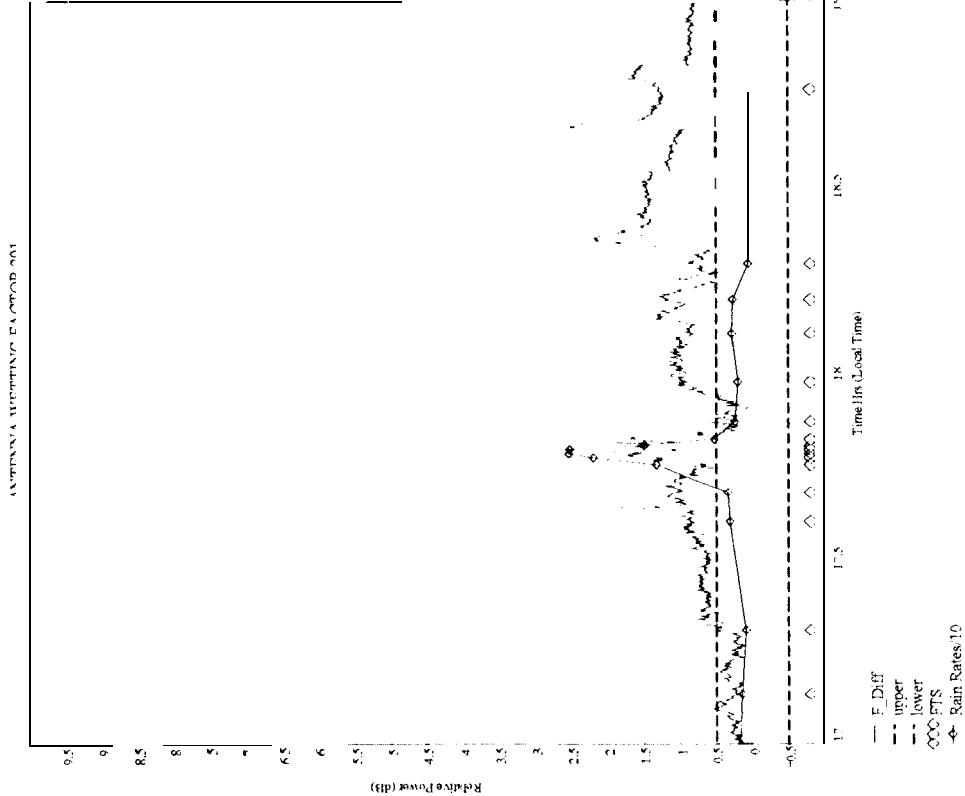


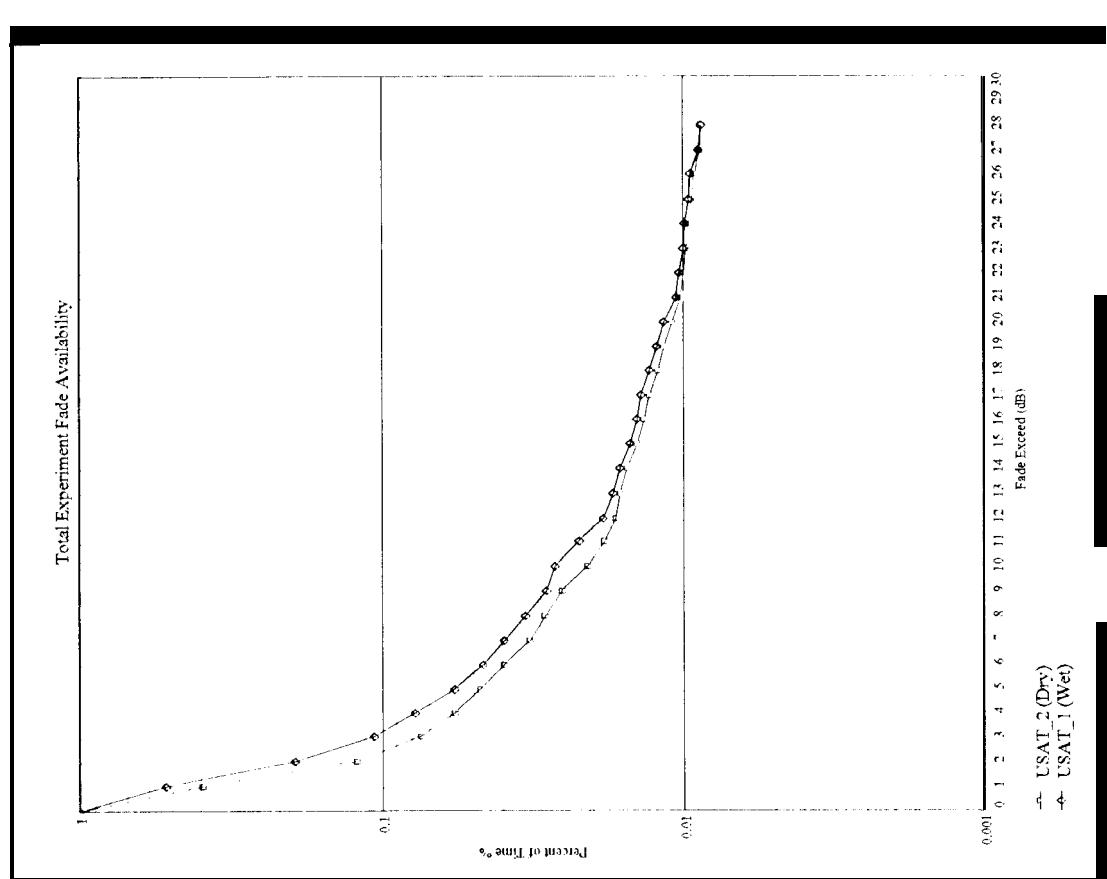
Fig. 3 - Rain Event 291

# Wet Antenna Studies at LeRC

## Experiment Fade Availability

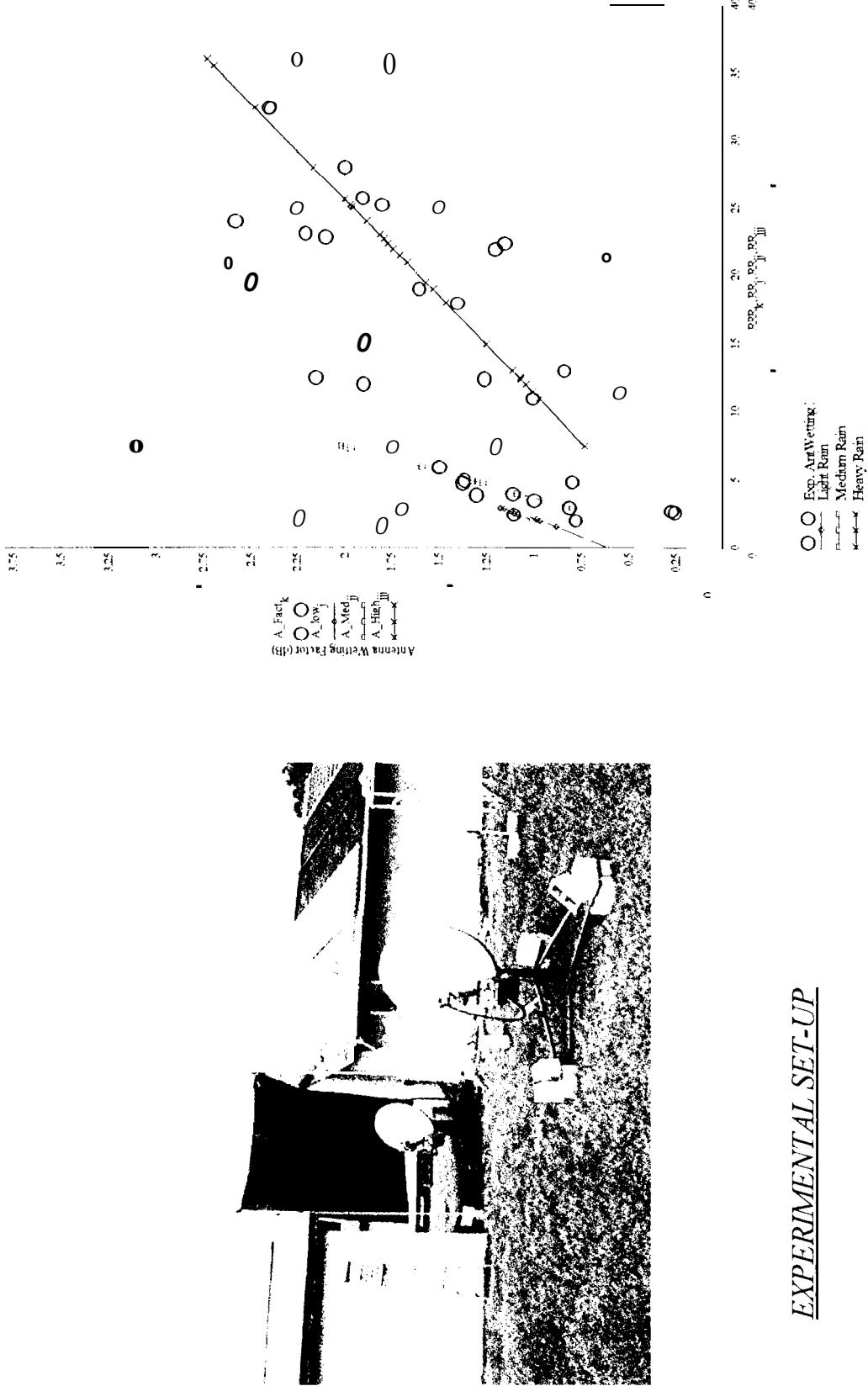
### Conclusions

- The antenna wetting factor for the 1.2 m antennas is very similar to the 0.35 m antennas.
- Maximum antenna wetting factor was measured to be between 3 and 4 dB.
- Wet antenna fade availability differed from dry antenna fade availability by 2 dB at lower fades (5-10 dBs)
- Rain shield was not perfect but seemed to work most of time
- Higher antenna wetting factors tend to occur at rain rates of the order of 10 - 40 mm/hr.
- At very high rain rates and high fades both antennas (dry and wet) have a negligible wetness factor.



# ANTENNA WETTING EXPERIMENT

4

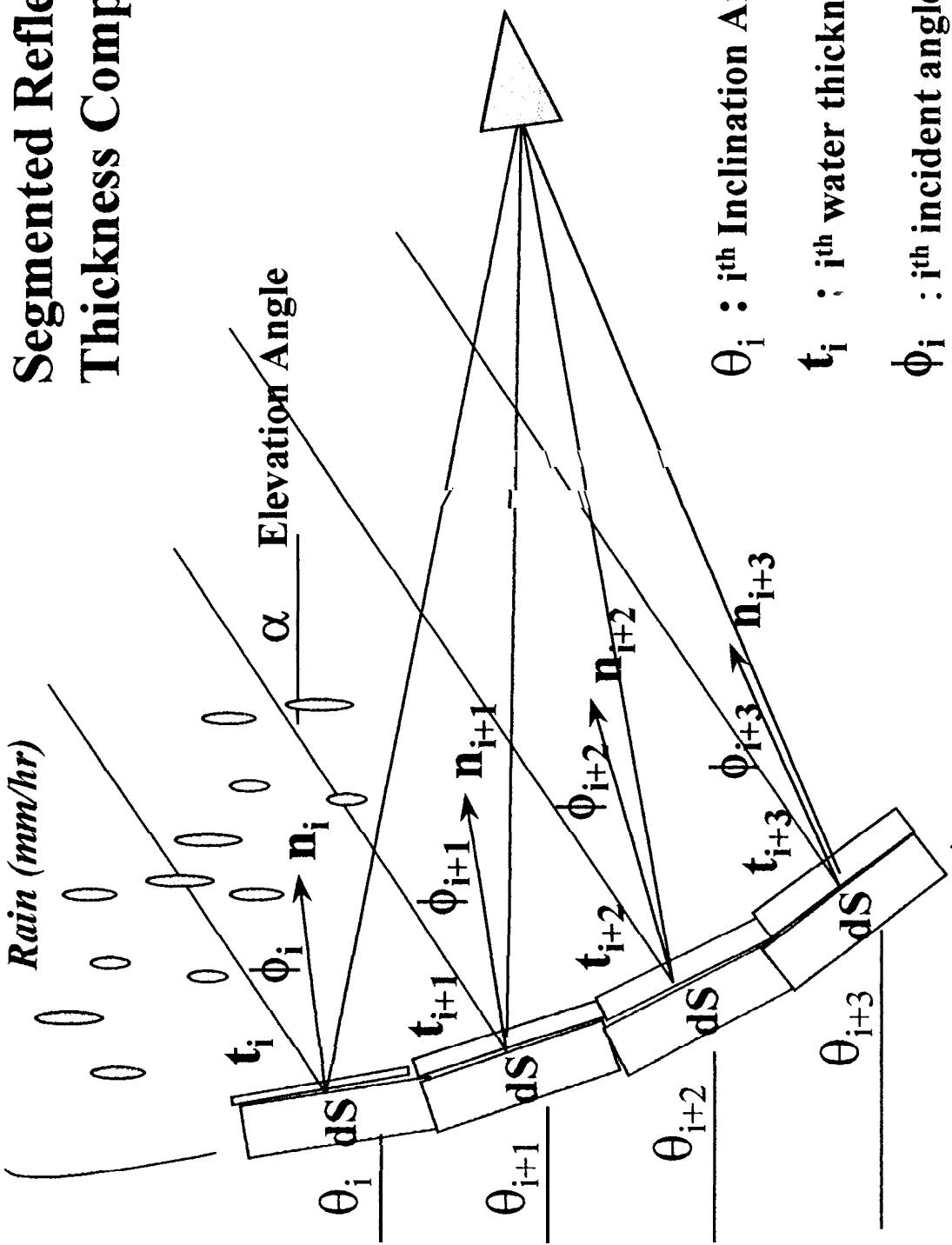


## EXPERIMENTAL SET-UP

## EXPERIMENTAL RESULTS

# Theoretical Model- WET REFLECTOR

## Segmented Reflector Thickness Computation



# Theoretical Model - WET REFLECTOR

Thickness of water sheet

$$\tau = \sqrt{\frac{3 \Gamma ds \mu}{\rho g \sin(\theta)}}$$

$\theta$ : Inclination angle

$\Gamma$ : Rain rate

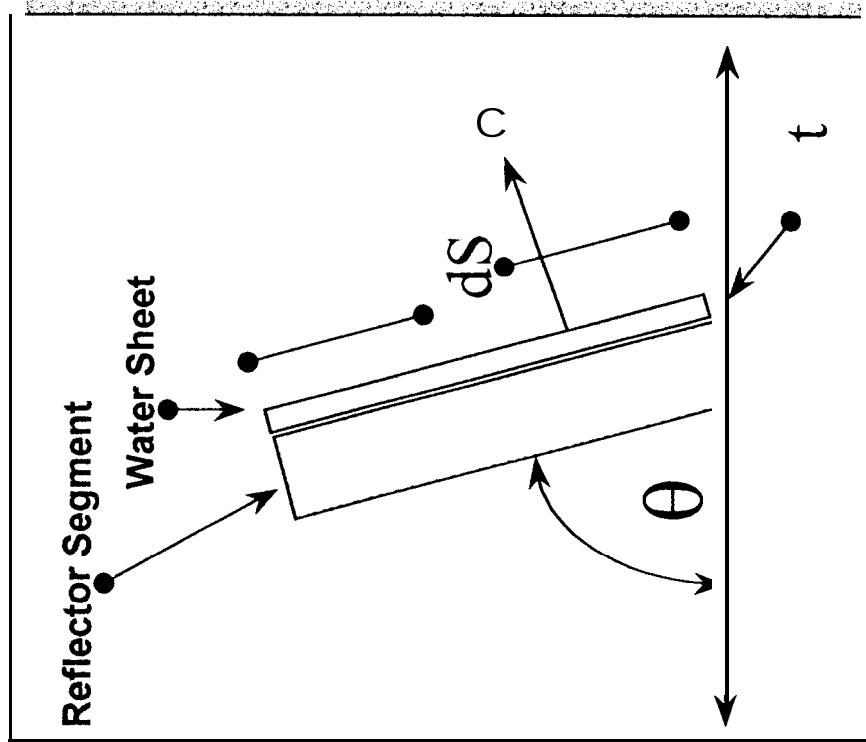
$\mu$ : Viscosity of water

$\rho$ : Density of water

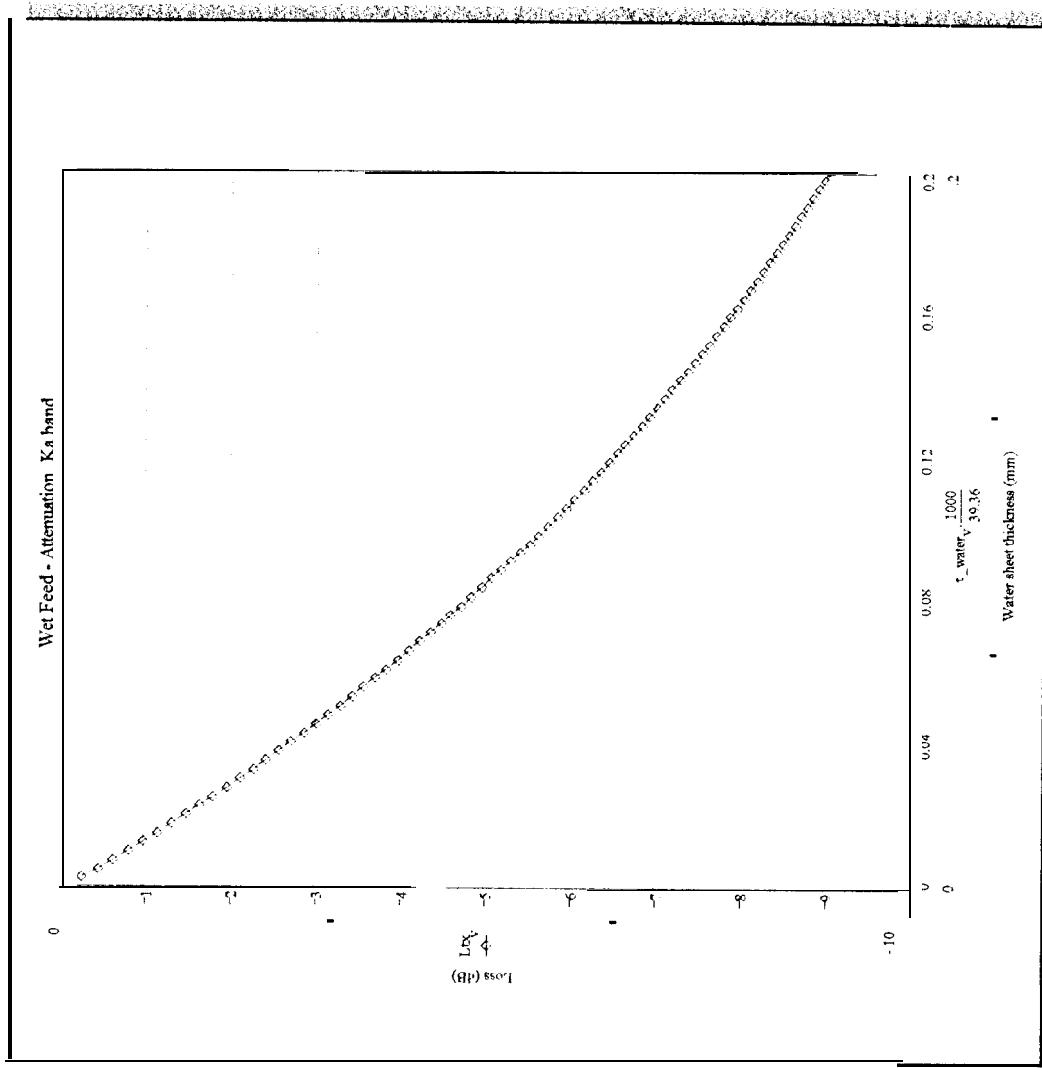
$g$  : Gravity

$ds$  : Differential length

$\tau$  : Average water thickness

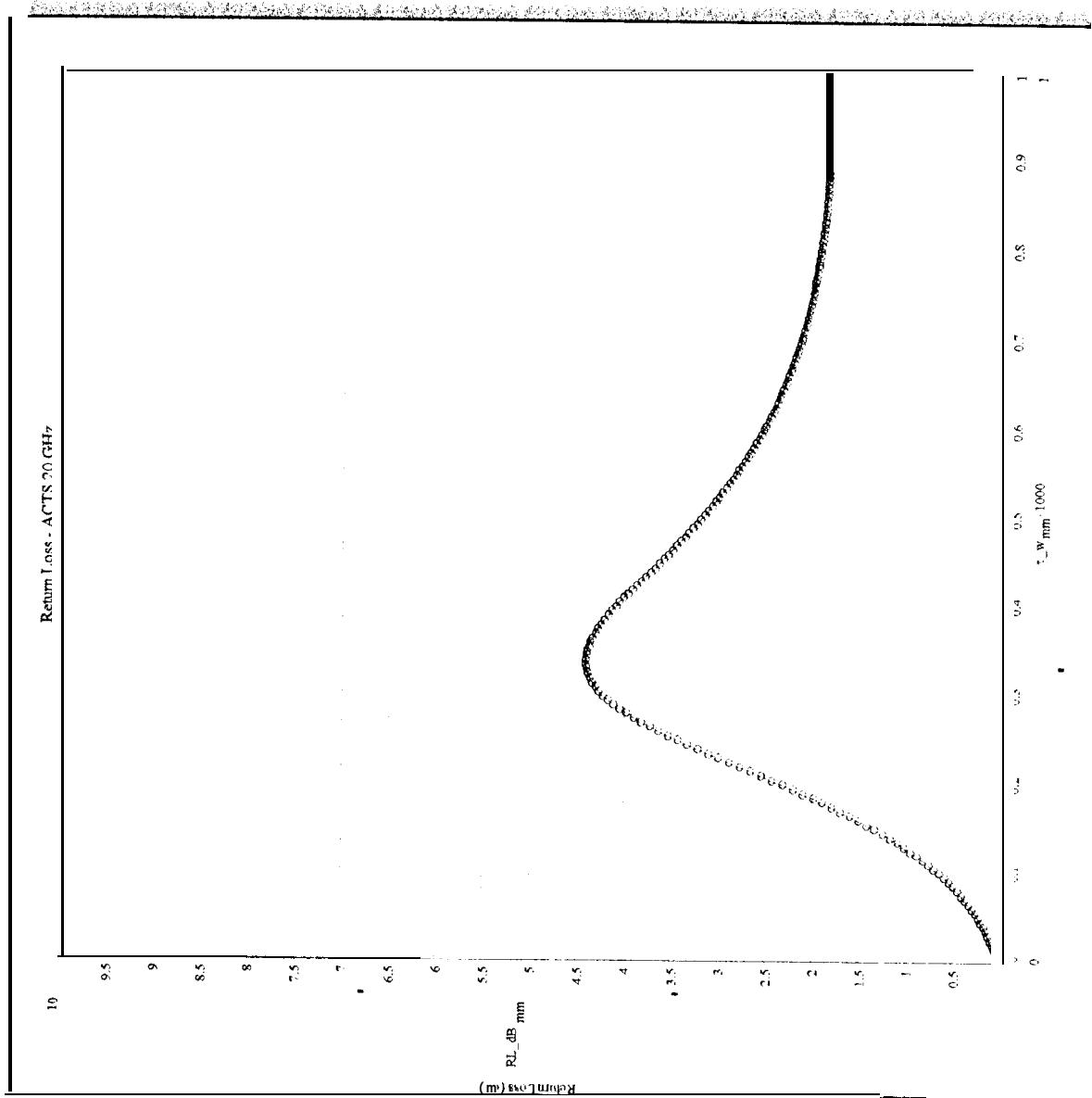


# WET FEED ANTENNA- RESULTS

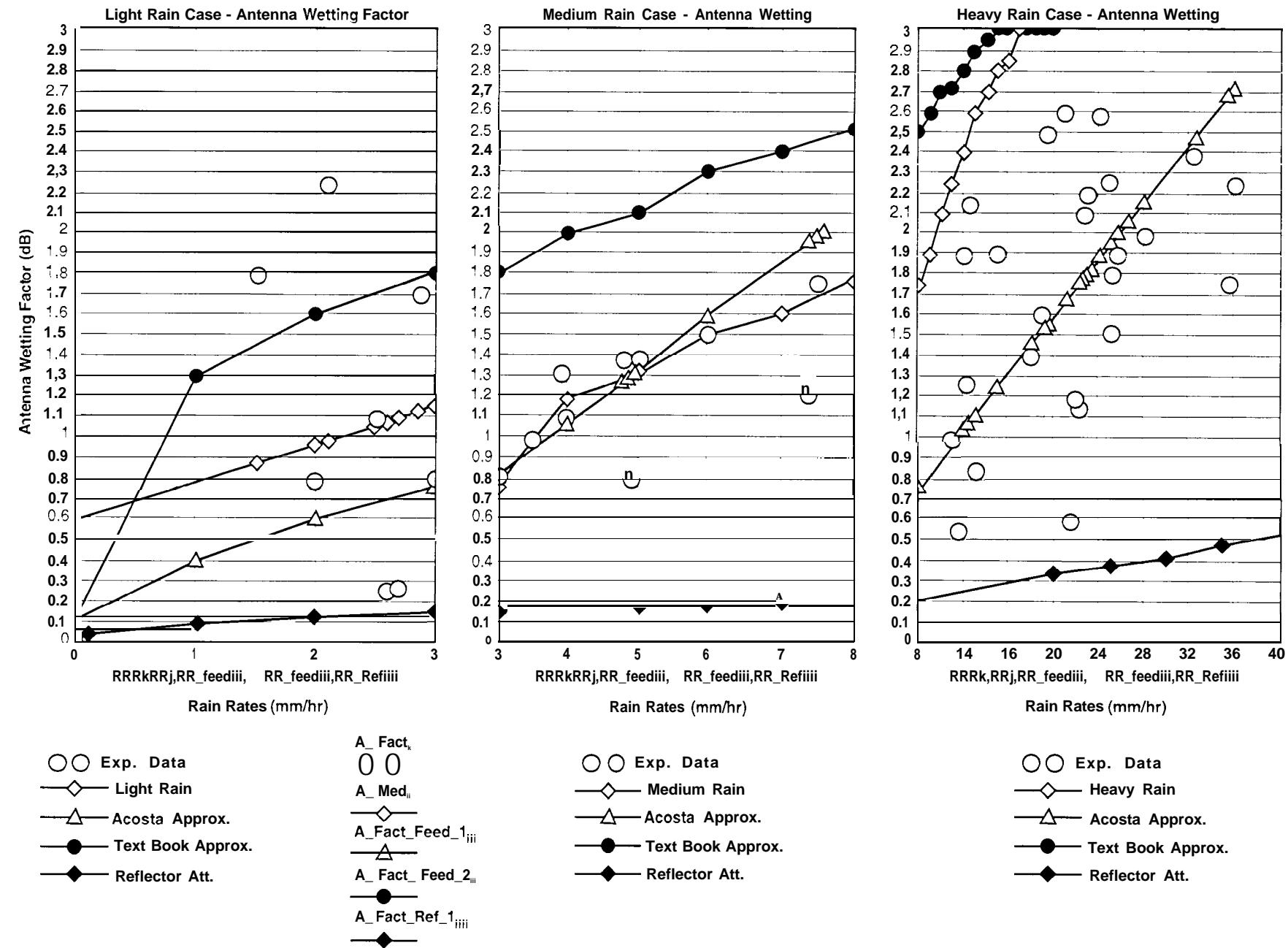


Transmission Line Model - signal loss  
vs effective water thickness

# WET REFLECTOR MODEL - Results



# THEORY vs. EXPERIMENT



# *Wet Antenna Studies at LeRC*

## Conclusive Remarks

- **The antenna wetting factor for the 1.2 m antennas is very similar to the 0.35 m antennas.**
- **Maximum antenna wetting factor was measured to be between 3 and 4 d and it was limited by dynamic range of the system.**
- **Wet antenna fade availability differed from dry antenna fade availability by 2 dB at low fades (5-10 dBs)**
- **Rain shield was not perfect but seemed to work most of time**
- **Higher antenna wetting factors tend to occur at rain rates of the order of 10-40 mm/hr but it may be limited to dynamic range of system.**
- **Antenna wetting factor is a random variable.**

**“Future work will include feed compensation and statistical data.”**